



Starry Night Exercise Book

FOR USE WITH STARRY NIGHT BACKYARD™

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Exercise 1: Using Starry Night

Starry Night is a sophisticated planetarium simulation that allows you to look at the stars as they appear from anywhere in our solar system. As well, the positions of the sun, moon and planets can be shown as they appear right now or far into the past or future.

In this exercise you will examine some of the tools that will help you complete the series of following exercises. More detailed explanations can be found in the Starry Night User's Guide.

1. The Control Panel

Many of the tools will use in Starry Night are located in the Control Panel, which runs along the top of the screen.



2. The Time Controls

These are some of the most useful and important features of Starry Night. Here you can set the exact date and time as well as go forward or backward in time by using different time steps.



The VCR-like buttons have the following functions:

- Change the time to the present time.
- Go back a single step (in the above example 3 minutes).
- Flow time backwards continuously (here in 3 minute steps).
- Stop time.

- ▣ Flow time forwards continuously.
- ▣ Time flows forward at a normal rate.
- ▣ Go forward in time a single step (3 minutes in this example).



This is the time step.

To set the time, date or time step, simply click on the item you wish to change. and little up and down arrows appear. You can use them to change the value, or simply type in the new number. To change the time unit (for example, from minutes to seconds) click on the word “minutes” and select “seconds” from the list which appears.

3. Try It Out

Action: Stop the time, if necessary.



Set the time to December 31, 1999 at 11:59:59 pm. The time palette should look like the illustration above.

Action: Advance time by a single (3 minute) step.

- a) Describe what has happened on the main screen and on the time palette.

Action: Now set the time step to 1 sidereal day. Advance time by a single step.

- b) What has happened on the main screen?

Action: Set the time step to 1 day (also called a solar day). Advance time by a single step.

c) Now what happened on the main screen?

d) Based on your observations, what seems to be the difference between a sidereal day and a solar day?

4. Using Prepared Files

Some of the exercises in this book have files ready for you to use. To use such a file, run Starry Night and then open the desired file using the File menu. The required files will probably be on the desktop. (If not, your teacher will tell you where to find them.)

As you work through the exercises, you will occasionally see the following:

Action: Open the file xxxxxxxx.

The xxxxxxxx's represent the name of the actual file.

Once you have opened the file you can carry out any further instructions. When you have finished with a particular file it is usually a good idea to close it before opening another file.

Note: If a dialog box opens asking you to save the file, choose Don't Save.

Make sure Starry Night is running and then carry out the following:

Action: Open the file Practice.

You should see a bright comet above the northern horizon as it appeared in late March 1997.

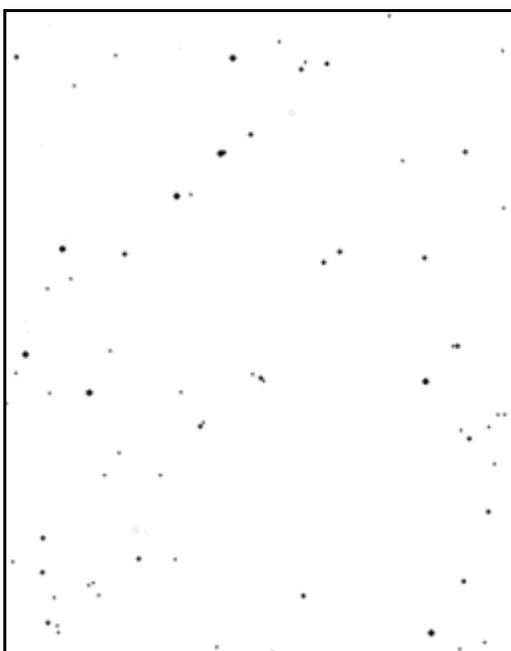
- a) What is the exact date and time of this view?

Exercise 2: The Constellations

On a clear night, far away from city lights, the number of stars you can see in the sky seems to be unlimited. They are scattered in random fashion but careful observation soon shows that the brighter stars at least seem to form easily recognizable patterns.

Throughout history sky observers have joined the brighter stars into patterns that represented animals, objects or heroes from their various mythologies.

In the absence of movies or television, a storyteller could simply point to the sky as to illustrate the story being told.



These patterns eventually formed the 88 constellations of our modern skies even though most people have a great deal of trouble seeing a “horse” or a “dog” or a “hunter” in the star patterns.

1. Ursa Major and Ursa Minor

One of the most easily recognized star patterns is the Big Dipper. The Dipper is part of the constellation Ursa Major.

- a) Outline the Big Dipper on the chart, above.
- b) The Little Dipper is part of Ursa Minor. Can you find the Little Dipper on the diagram? It's a little more difficult since some of the stars aren't as bright.

Action: Open the file Constellations.

c) Check your diagram of the two Dippers with the ones shown. Label Polaris on your diagram.

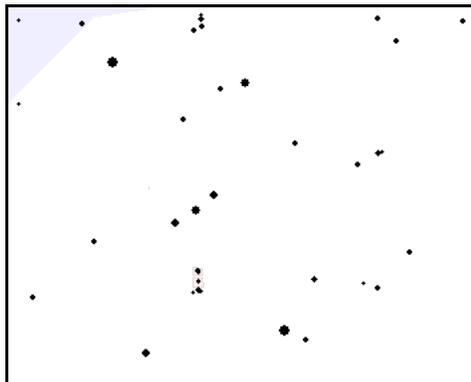
Action: Use the time controls to make time flow forward continuously for some time.

d) Describe the motion of the constellations with respect to Polaris.

e) Notice that some constellations never go below the horizon. Such constellations are called circumpolar. List two or three circumpolar constellations.

2. Orion

The stars shown at the right form a very obvious pattern in our winter skies – Orion, the mighty hunter of Greek mythology.



Action: Open the file Orion

- a) Outline the accepted pattern of Orion (or make up your own!) on the diagram above.
- b) Let the cursor hover over the brighter stars in Orion to see the star names. Find and label the following two stars of Orion on your diagram:
 - Rigel
 - Betelgeuse

3. Winter Constellations

- a) List three other constellations near Orion that may also be seen in our winter skies. What does each constellation represent? Right-click the mouse near the constellation name (but not directly over a star). A list of options appears. Choose the option “Select xxxx” where “xxxx” is the constellation name. This displays a picture of the constellation. Now click on the “Edit” menu along the top of the screen and choose “Get Info”. This opens a small window with more information about the constellation.

4. Spring Constellations**Action: Open the file Spring**

- a) List and describe 4 constellations seen in the spring. (Use the method described above to display a picture of the constellation and to bring up the information window.)

5. The Stars of Northern Summers

Action: Advance the time a single step forward

Note: One step is equivalent to about three months.

- a) List and describe four constellations that are visible at this time. .

6. Summary

You have now examined some circumpolar and some seasonal constellations.

- a) Why do you think some constellations can not be seen in the summer?

7. Extensions

- a) Is it possible to live somewhere on earth where *all* constellations are circumpolar? Where would this be?

Exercise 3: The Solar System

The sun is our most important neighbour in space. In addition, planets, asteroids and comets make up our solar system. In this exercise, you will discover how these objects are related to each other.

1. The Sun

a) Why is the sun our most important neighbour in space? Give at least three reasons.

Action: Open the file Sun. Make time flow forward until the sun is completely covered.

b) What event is taking place? Does this illustrate one of your answers to **a**? Explain.

2. Other Members of the Solar System

Action: Open the file Solar System

a) List the four inner planets shown. Can you name the rest of the planets which are too far away to be seen in this diagram?

- b) Describe the orbits of the planets. (The small stick-like marker on each orbit represents the closest position of that planet to the sun.)

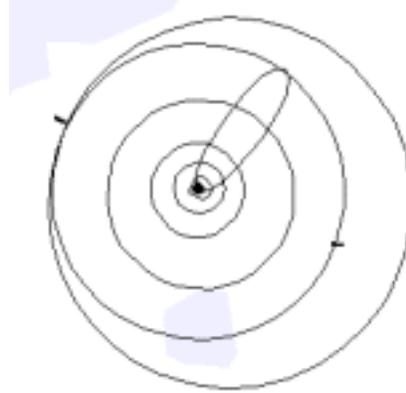
Action: Step time forward by two steps.

- c) At what time of year is the earth closest to the sun? Carry out the action below to find out. Does the answer surprise you? Why?

- d) Outside the orbit of Mars is Vesta, an asteroid. How does the orbit of Vesta compare to that of a planet?

- e) Find the object marked “Halley’s”. What kind of an object is it? How do you know?

- f) The diagram at right shows Halley's complete orbit. Compare Halley's orbit with that of the planets. How does it differ? How is it the same?



- g) Challenge! Can you label each planet's orbit on the diagram? Do it!

3. Orbits

Action: Press the Forward button in the Control Panel to allow time to flow forward continuously.

- a) Describe the motion of the planets as follows: In what direction are they moving? Are all planets moving at the same speed?
- b) Describe the motion of the asteroid Vesta.

4. The Orbit of a Comet

Action: Load the file Halley.

When Edmond Halley observed a comet in 1682 he believed that this comet was also seen in 1607 and 1531. He then predicted that the comet would once again be seen in 1758.

Action: Allow time to flow forward until the comet is again near the sun.

a) Was Halley correct? Try to estimate when the comet was closest to the sun. (The point closest to the sun is called perihelion.)

b) Using the data above, try to predict the next date of perihelion.

c) Predict the first date in the new millennium when the comet (which was named after Edmond Halley) will again be near the sun.

- d) Describe the motion of Halley's comet as it completes one orbit. Can you explain what is happening?

Note: Use Starry Night to check your answers to Parts b), c) and d)

5. Extensions

- a) The model of the solar system shown by Starry Night is called a heliocentric model. What does the term heliocentric mean?

- b) For hundreds of years people believed that our solar system was geocentric. How does a geocentric model differ from a heliocentric?

- c) Which model do we believe in today? What evidence do we have?

b) Does the planet you found in **1b** share this motion?

Action: Continue advancing the time until it is 7:45 am.

c) What happens about this time?

3. Moving On

Action: Advance the time until the sun disappears off the right side of the screen (about 9:30 am)

a) Observe and describe the motion of the sun.

Action: Change directions to SOUTH (type "S") and continue advancing the time one step at a time.

Note: *Because it's daylight, you can't see the stars anymore. However, the constellation outlines will allow you to follow the motion of the stars.*

b) Observe and describe the motion of the sun and stars.

Action: At about 3:30 p.m., switch your view to WEST (type "W") and continue advancing time and observing the motion of sun and stars until about 10 p.m.

c) Describe the motion of the sun and stars as accurately as you can.

d) At about 9:00 p.m. the planet Jupiter enters the picture. See if you can find it.

Action: Advance time to midnight in single steps.

e) Describe Jupiter's motion.

4. What about the Moon?

Action: Change your view back to EAST (type "E") and advance time several steps

a) Does the moon share the motion that you have observed so far?

Exercise 5: Direct Motion

All celestial objects share the east-to-west diurnal motion caused by the earth's rotation. We now know that with respect to the stars, the earth completes one rotation in about 23 hours and 56 minutes. But does the earth have another motion? Let's investigate.

1. The Moving Sun

Action: Open the file Solar motion

The time is 6:00 pm on August 20, 1999. Since daylight is turned off, you can see that the sun is "in" the constellation Leo.

a) Why is the word "in" in quotation marks?

The time interval has been set to 1 sidereal day. Recall that this is the time required for one complete rotation of the earth with respect to the stars. Note the constellation boundaries (in gray) which will help you decide which constellation plays host to the sun.

Action: Advance the time by one step.

b) In which direction did the sun appear to move?

c) Why did the stars not move?

d) How much time has elapsed? (Check the time palette).

e) Can you predict into which constellation the sun will move next? Try.

Action: Advance time by several steps until the sun has “entered” another constellation.

f) How many different constellations host the sun during a full year? Guess!

To help you find the answer to this question, let's make a few changes to the time step.

Action: Change the time step to "5" from "1" and to "days" from "sidereal days". Choose Guides from the menu along the top and then choose "Ecliptic".

Changing from sidereal days to days will keep the sun in the picture and changing from 1 to 5 days speeds up the action.

The *Ecliptic* line traces the path the sun makes in the sky.

Action: Step through time until a full year has elapsed and the sun is back in Leo.

g) List the constellations the sun passes through during the year.

h) Where have you heard or seen some of these constellation names before?

2. The Eastward Motion of the Moon.

The moon also shows this eastward motion against the stars.

Action: Open the file Lunar motion and advance the time by two or three steps.

a) How does the eastward motion of the moon compare with the eastward motion of the sun?

- b)** Does the moon follow the ecliptic? Look carefully! (Turn on the ecliptic line the same way as you did before.)

3. Summary

The sun, moon and the planets as well (at least part of the time), all move eastward among the stars. This motion is sometimes called DIRECT MOTION.

- a)** What may cause the direct motion of the sun and moon? (Hint: Check the Introduction!)

4. Extensions

If time permits and with your teacher's permission try one of the following:

- a)** If the earth rotates once in 23 hours and 56 minutes then why is the day is 24 hours long?
- b)** Open the file *Phases*. This will show you a magnified view of the moon. Allow time to flow forward either continuously or stepwise. You can now follow the moon through all of its phases. Can you name these phases?

Exercise 6: Retrograde Motion

If you plot the path of the planet Mars carefully for some time, you will notice something strange happening once in while. In this exercise, you will investigate this strange behaviour of Mars and try to come up with an explanation.

1. Mars in Motion

Action: Open the file Mars-retrograde

The sky is shown on Jan. 1, 1999 at 12 noon. Daylight has been turned off so that you can focus on Mars' motion against the background of the stars. The time interval has been set to 1 sidereal day which means that the stars will appear not to move as time advances.

Action: Advance time by nine single steps.

The trail Mars leaves behind will make it easier to follow its motion against the background of the stars.

a) What object passes Mars?

b) In which direction is Mars moving? (Recall that this is called *direct motion*.)

Action: Now allow time to flow forward continuously until the date reads about 8/15

- c) Describe and make a sketch of Mars' path.

- d) On your sketch, mark the dates on which Mars appears to change direction. Use the Single Step Backward button in the Control Panel to move back in time and find these dates.
- e) The westward part of the motion is called retrograde motion. Label the retrograde part of Mars' path on your diagram.
- f) What is the name of the bright star Mars passes near the beginning of June 1999?

2. What Causes Retrograde Motion?

- a) What do you think causes this looping motion of Mars?

Action: Open the file retro2.

You are now looking at the inner part of the solar system from 2.8 astronomical units above the north pole of the sun. Notice the position of the Earth and Mars.

Action: Flow time forward to about 6/15/1999.

b) Which is moving faster in its orbit; Earth or Mars? What is Earth “doing” to Mars?

c) Is Mars actually moving “backwards” at any time?

3. Summary

By examining the motion of Mars as seen from the Earth as well as from a point above the sun you should be able to answer the question:

a) What causes retrograde motion?

4. Extensions

All planets further from the Sun than the Earth clearly show this retrograde “loop” when seen from our skies.

Action: Open the file Jupiter-retro and then flow time forward to illustrate the retrograde motion of Jupiter.

Exercise 7: Building a Deep Sky Database

Far beyond the planets and our solar system lie the stars, material (mostly dust and gases) that will someday form stars and material that once belonged to stars. This is the “Deep Sky”.

Stars are found alone (like our sun), in pairs or triplets and in large groupings called star clusters. As well, stars, star clusters and dust and gas collect in huge groups called galaxies.

In this exercise, you will build a database of a selection of these deep sky objects.

1. The Messier Catalog

Many of the best of the deep sky objects were first catalogued by Charles Messier in the 18th century. Although some of these objects are so far away that small telescopes show them only as small blobs of light, some are bright enough to be seen through binoculars. Starry Night shows images of the objects as photographed by large telescopes.

Action: Open the file Deep Sky. Hold down the control key (Windows) or the command key (Macintosh) and type F.

A “Find” dialog box opens.

Make sure the box marked “Magnify for best viewing...” has a check mark next to it. This means that you will see a magnified view of the object you select.

Action: Type M104 in the space beside the words “Name Contains”, then click the “Find” button.

This will zoom in on M104, the Sombrero Galaxy.

Action: Double click on the center of the image of M104

An information box opens where you can find the necessary information to help you complete your database.

The information for M104 is shown below.

No.	Type of Object	Name or Description of Object	Distance {l.y.}	In Constellation
M104	galaxy	sombrero galaxy	50 000 000 ly	Virgo

Now you can complete your data base (see next page) by following the example above.

2. Database of Deep Sky Objects

No.	Type of Object	Name or Description of Object	Distance {l.y.}	In Constellation
M1				
M2				
M6				
M8				
M11				
M13				
M17				
M20				
M27				
M31				
M42				
M44				
M45				
M57				
M81				

